

directly opposite of what is called Frank Eastman Park, and about 1,000 or 1,500 feet above the Boise Artesian Hot & Cold Water Co.'s (middle) reservoir. The channel at this point is fairly regular and nearly straight for about 1,000 feet. We took the cross section with an 18-inch Y level and found the bottom to be practically level. The high-water marks were determined by the wash indicated in the nearly perpendicular side of the channel, and were indicated by slight demarcations and the deposit of slight débris. The channel at this point is practically entirely in sand, although some bowlders, up to 6 or 8 inches in diameter, show in the bottom, about half bedded.

That the velocity must have been very great is indicated by a stone about 2 feet long by 8 inches square, which evidently had been washed down by the water. The amount of water running into the channel can not be determined with any degree of accuracy, and the results which we obtained are to be taken only as an approximation.

The width of the channel, as stated, was 56 feet, and the average depth of water 5.1 feet, so that the water area was 285.6 square feet. A very uniform grade of 3 feet per hundred, or 1 foot in 33 $\frac{1}{3}$, was found. Using $n=35$, in Kutter's formula gives a velocity of 19.9 feet per second, and a quantity of 5,712 cubic feet per second. Using $n=40$ feet in Kutter's formula gives a velocity of 17.4 feet per second, and a quantity of 4,998 cubic feet per second.

The values of "n" were taken from Hand Books of Trautwine, Frye, and Merriam. Trautwine says: "n should be taken as 30 in canals in bad order and regimen and strewn with detritus." Frye says: "n=35 for canals and rivers in bad order with great quantities of stones and weeds, and use n=40 for rivers in extremely bad condition." Merriam says: "Use n=35 in channels in gravel in bad condition, strewn with stones and detritus." Thus the use of n=35 can be construed as fairly accurate, and n=40 as conservative.

The streets in the north end of town, which were flooded, are nearly all 60 feet wide, and if five streets were flooded to a depth of 1 foot the quantity of water would be nearly the same as that found by the measurements indicated above.

Inquiry as to the time of beginning and ending of the flood leads to the conclusion that it was nearly at its maximum height for approximately 45 minutes, after which it suddenly receded. It is believed that an estimate of 5,000 cubic feet per second for a period of 40 minutes would be fairly representative of the total amount of water. This would make 12,000,000 cubic feet, or 275 acre-feet. The area of the watershed above the upper reservoir is approximately 5 square miles, hence the run-off would represent an average rainfall over the watershed of 1.05 inches. Mr. Clyde Baldwin, in charge of the Water Resources Branch of the United States Geological Survey in Idaho, estimates that for such a heavy rain on so steep a slope as is found over most of the Hulls Gulch watershed the run-off would be 50 per cent of the total rainfall. This would give an average rainfall over the watershed of 2.10 inches.

The adjacent gulches discharged a considerable amount of water, but not sufficient to cause serious damage, hence it is probable that the heavy portion of the storm was confined to the Hulls Gulch watershed. This being true, it is probable that part of the watershed received more than the average amount, while other parts would receive less. There is, however, nothing to indicate the occurrence of anything more than a very heavy shower, and had it not been for the steep slope of the country and the narrow outlet of the gulch, which concentrated it, the storm would not have been classed as a cloudburst.

A notable feature of the storm was that it was not accompanied by thunder.

The closing storm of the rainy period reached its greatest intensity about 5 p. m. on the 26th, when the heaviest short downpour in the history of the station occurred. The rainfall amounted to 0.13 of an inch in 2 minutes, 0.23 of an inch in 5 minutes, and 0.26 of an inch in 10 minutes. In the hills, a short distance from the city, the rainfall at this time was very slight.

WINDSTORM AT SEATTLE, WASH.

By G. N. SALISBURY, Section Director.

A sharp wind squall, or, as some considered it, a small whirlwind of a nature resembling a tornado of small intensity and extent, occurred at Madison Park, in the northeast suburbs of Seattle, on the 6th, at about 4 p. m. The disturbance was scarcely over a minute in duration. A black, threatening cloud (several were sure it was a funnel-shaped one) at a height of 25 to 75 feet, swept rapidly down East Madison Street toward the northeast to the lake (Lake Washington) shore at Forty-third and Madison. At the moment of its arrival a wind blast sprung up instantly and blew with violence. Some said the roar of the wind was terrific. No one was killed or injured, but two or three persons were blown down; others saved themselves by clinging to fences, etc. Several trees were broken in twain, and there was much damage to trees and shrubbery in the vicinity. A tower on an old pavilion in the park was blown down; estimated damage \$500. The damage to trees, shrubbery, etc., in the little park was estimated at \$200. A large chestnut tree was broken short off (no evidence of twisting) about half way up at a point about 9 or 10 inches in diameter. A large branch, 6 or 7 inches in diameter, was broken from a sycamore tree, and a large cottonwood tree was broken short off half way up (some 40 feet from ground) at a point 7 or 8 inches in diameter. All of these fell toward the north.

At Fortieth and Madison, the Thomas Place, or "Old Homestead," several trees in a yard, full of large trees and shrubbery, were broken off. A large locust was shattered. A fir, or spruce, about 9 or 10 inches in diameter, was broken short off 25 or 30 feet from the ground. Several other trees in the yard were broken off, and many branches of a line of cottonwoods in front were stripped off. Four panels of an old, decayed fence (picket) were prostrated. Everything fell toward the north. A greenhouse of the Washington Floral Co. had many panes of glass broken. At the Hill ostrich farm, Forty-first and Madison, 20 rods of a close boarded fence were prostrated; the fence was old and shaky.

There was to me, when I investigated next morning, no evidence of a whirl, but every evidence of a straight-line squall.